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Developing Interactive Learning for Environmental Issues

Meriesa C. Elliott
Iowa State University

Developing interactive learning for environmental issues

by

Meriesa Elliott

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Program of Study Committee:
Alex Braidwood, Major Professor
Sunghyun Ryoo Kang
Mimi Wagner

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ABSTRACT

The environment is being negatively affected by the behavior of human beings. Climate change, while a natural occurrence, is happening at an unnatural pace, sped up by human actions. Even with these things in mind, it seems an impossible task to get people to move toward positive environmental impacts. While many people are aware of environmental issues, they don't fully understand what actions are contributing to the problems, what alternative options they have, or how they can help alleviate the problem. With that in mind, I examine how effective interactive design can be at creating a learning environment by utilizing fun and interaction to generate interest which creates an effective, positive learning environment. When it is fun and interactive, people seek information naturally and they associate that new information with positive emotions.

CHAPTER I

INTRODUCTION

Many social organizations exist to raise awareness, create change, or raise money for a cause. All too often though, their goals aren't reached or they go largely unnoticed. I believe that effective use of interactive design could increase their chances of success. Events, displays, or demonstrations that involve the audience and present the information to them in an unconventional way can have a more profound and long-term effect because it catches attention, it creates interest, and prevents the viewer from remaining passive. Designing with interactivity and fun makes for more effective learning, and when it comes to the environment, we need raise awareness and inform, but also remove that passive element that makes people think it's someone elses problem. If we can make the subject of the environment a personal issue, we might stand a chance at saving it. Toward this goal, I will examine different exhibits and look at what makes them successful. Then, I will delve into the psychology that comes into play with interactivity and learning. Finally, I will put this into practice and create four exhibits that utilize the tools discovered through the literature review.

To begin, I'd like to look at The Fun Theory, because their exhibits and projects have made some waves through social media sites and they've had reasonable success in achieving their goals. When it comes down to it, all they've used to achieve their success was fun, maybe a fair bit of technology as well, but everything they used had the sole purpose of making the interaction fun, and that was all it took to get people moving. Moving into the psychology supporting why interactive learning works, we'll look at research done by Manubay et al. which

examines the effectiveness of an environmental exhibit at the Brookfield Zoo near Chicago, and Steinemann et al. which examines the role that interactivity plays in *Games for Change*, which are games that are designed to raise awareness about issues across the globe. The literature review will conclude by looking at how interest plays a role in learning and how interactivity can be used to fuel interest.

After reviewing literature on the subject, of which there was little specifically related to interactive exhibits and learning, I set about the task of putting what I've learned to practice. My methodology was to design interactive exhibits that combined fun with information. Each project was interactive in a different way, from pouring water onto soil, to playing in the sand, from playing a board game with others, to standing in front of a screen by yourself. Mixing and matching different elements such as social interaction, interactivity, fun, and interest.

CHAPTER 2

LITERATURE REVIEW

Different Types of Installations

The Fun Theory's main tool is changing the interaction associated with preexisting objects, often only requiring small changes to the interaction. One of The Fun Theory projects in action is the "Bottle Bank Arcade." Volkswagen funded this project and the goal was to raise awareness about health, safety, and environmental issues painlessly. The Arcade kiosk was a large metal box with six circular holes, each with a light above it. When the user approaches the Arcade, one of the lights will be lit, and if the user puts a bottle in the corresponding hole, they get points and sounds that you might associate with a retro arcade are played. The light moves to a different hole and the user must put a bottle in that hole to gain more points. The Arcade keeps track of the points collected and even shows the day's high score.

The use of the arcade sounds and the challenge of getting a high score makes the mundane task of recycling more enjoyable. As a result, more people recycled while the arcade was there. The "Bottle Bank Arcade" is an interactive installation and even has a reward system, albeit in the form of intangible points. It is exciting and fun, and the user gets a positive response back from the machine. The end result of the "Bottle Bank Arcade is the creation of positive subconscious thinking about recycling, which will lead to greater chances of recycling.

Another project created by The Fun Theory is the "The World's Deepest bin," which was an experiment created to get more people to throw their waste in a garbage bin. "The World's

Deepest Bin" is a blue trash bin that has a simple sound effect that is triggered when trash is thrown in the bin. This simple sound effect is that cartoonish sound of something falling for a long time, followed by a thump. Using this simple sound effect in a trash bin can change the experience, creating excitement, curiosity, and wonder in the user that gets them to pick up more trash for fun. Caring doesn't translate into action because sometimes they don't feel like they have time, sometimes it's just that being environmentally friendly is harder, and sometimes it's just because they care but don't understand, but often, a lack of complete knowledge is a major barrier. The Fun Theory operates on the premise that all of these excuses can be moved aside by changing the interaction to include fun. The interaction and the feedback that they got from the trash bin motivated people to pick up more trash because it was fun. Even if they were in a hurry, it was just too good to pass up, some people did a double-take and had to turn around to see what that was. Using this method, they successfully changed people's behavior for the better by making the usually mundane task interesting. The Fun Theory basically outlines their projects as, identify the problem, develop a goal related to the problem, come up with a fun potential solution, observe the results. The "World's Deepest Bin's" theory board would have looked something like:

Step 1. The Problem: People are littering instead of tossing it in a bin.

Step 2. Goal: Make tossing the waste in the bin fun, so people will do it more often.

Step 3. Solution: The "World's Deepest Bin" is first theorized.

Step 4. Result: Enjoy the fruits of your labor. In one day, 72 kilograms of trash was collected in the bin, which is 41 kilograms more than the average waste bin in that area.

With results from examples like these, it seems possible that finding room for fun in the equation could be what many other movements or groups are missing. After all, asking them to perform the better behavior is typically asking them to do something that will require more work. Despite how righteous the cause that you are working toward might be, if they aren't currently working along with you, you should assume that they aren't as interested in helping, so give them a reason, make it fun.

The Psychology Behind it All

Media, such as newspapers and news stations are an effective tool for changing behavior, and they seem to do a much better job of it than those of us that would like to enact positive change. How do they do it so well? Media has been used to move the masses for ages and the tools used in media to affect this change in behavior could be very useful if used for better purposes, such as moving toward sustainable energy and reducing waste to preserve this planet for future generations. Before the Internet, before the television set was a common household item, when it was just radio and newspapers, media was still used to sway the masses. In 1929, Edward Bernays convinced women in the US to smoke cigarettes by getting some women in a parade to smoke and then telling the press that they were torches of freedom. During a time when women were fighting for equality, this persuaded a lot of women to start smoking, which is what the cigarette companies wanted when they contacted Bernays. (Curtis, A. 2002)

An entire society was changed from buying what they need by how well it would satisfy that need, to buying what they want in the belief that it will make them happy, all through the effective use of marketing and media. Simply by changing how they portrayed cars in their advertisements, they turned the car from a tool for travel to an erotic statement of manhood,

forever changing the way people buy cars and the way we see them. If such a power had been used for the betterment of the world, instead of for greed, just imagine what we could accomplish.

Exhibits can be very effective tools because you are generally taking the viewer out of their comfort zone and placing them in a space of your design. These can essentially prime a viewer to accept new information. A good example of this is an exhibit called the “Quest to Save the Earth”, a life-size board game at the Brookfield Zoo near Chicago, Illinois. The “Quest to Save the Earth” takes groups through a number of interactive games to learn about how their daily actions affect the environment and what they can do differently to have less of a negative impact.

The first event in the exhibit is called the “Bog of Habits” and participants move along 28 stepping stones that each bear an environmentally charged behavior. Research was done by Grace Manubay et. al. to determine what kind of an impact the “Quest to Save the Earth” was actually having. To determine how effective it is, the group did two surveys, one immediately after going through the “Bog of Habits” and one several months later. In addition, they also monitored the number of environmental brochures that were picked up to gauge environmental interest. Table 2.1 has a breakdown of what the initial survey consisted of, which was given to Bog participants right after they finished the exhibit, and given to non-Bog participants as they left the zoo.

Table 2.1 – Initial Survey Breakdown

	What was surveyed	Hypothesis or Purpose
Independent Variables	Demographics	Purpose: To collect information on visitor's backgrounds and motivations for visiting the Zoo.
	Past Behaviors	Purpose: This scale allows for controlling of past behavior differences between Bog and Control visitors.
Dependent Variables	Attitude	Hypothesis: Bog visitors will express more favorable attitudes toward taking action to resolve environmental problems and express a higher level of knowledge about what they can do about environmental issues.
	Interest in Increasing Environmentally Responsible Behaviors	Hypothesis: Zoo visitors who play the Bog of Habits will show an increased interest in environmentally friendly behaviors compared to those who do not play.

The questions that were asked in the dependent variable section of the survey were answered on a 1-5 scale. In the "Interest in Increasing Environmentally Responsible Behaviors" section, participants were asked if they were interested in performing environmentally friendly behaviors, such as buying refills for cleaners or soaps, higher numbers would indicate that they are more interested. The results for this section are outlined in Table 2.2 below, and it is interesting to see that the Savings in the Home and Energy Conservation results were fairly close, but the Time Commitment showed a pretty large difference.

Table 2.2 – Results of Intended Behavior Survey

Category	Overall Average	Bog Average	Non Bog Average
Savings in the Home: Refills for cleaners or soaps Pack lunch in lunchbox Shorter, cooler showers Locally grown produce	4.08	4.14	4.02
Energy Conservation: Reduce number of car errands Clean refrigerator coils Air dry laundry	3.59	3.69	3.49
Time Commitment: Compost food scraps Write representatives in congress Volunteer for conservation organization Plant native plants in garden Discuss being Earth friendly with others Buy sustainably harvested wood products Donate money to help the environment	3.04	3.23	2.87

To measure outside the realm of self-report, which is sometimes inaccurate or untruthful, they also gave coupons to “Bog of Habits” participants and a control group of random visitors whom did not participate in the Bog of Habits. The coupons could be redeemed for a brochure on how to be environmentally conscious. Then, tracking the number of coupons that were redeemed, they could see how many were interested enough to get a brochure, and real interest is tracked. We can see in Table 2.3 that, while the numbers were low for both the Bog participants and the control group, there was a marked difference between the two. We can see the Bog of Habits is certainly having an effect. While still relatively low, it is nonetheless an increase of 300% over the control group.

Table 2.3 – Rate of Coupon Redemption

	Percentage that redeemed the coupon	
	Yes	**No**
Visited Bog	11.3%	88.7%
Didn't visit Bog	3.4%	96.6%

But how long lasting is this effect? A follow-up survey was done several months later to determine if there were significant lasting results, shown below in Table 2.4, and it reveals that the interest doesn't last. Within four to six months, the bog visitors had nearly returned to the levels of the control group. This was likely because after leaving the zoo, returned to their regular habits and daily life and without some sort of reinforcement, the interest decays.

Table 2.4 – Follow-up Phone Survey

	Visited Bog	**Did Not Visit Bog**
Number surveyed	29	20
Visited the Zoo more than once this summer	79%	70%
Returned to the Zoo for a specific exhibit	87%	43%
Talked about time at Zoo	100%	100%
Learned about how their choices affect the Earth	72%	35%
Learned about relationship to Earth	69%	40%
Said the Zoo encouraged them to change their behaviors	35%	15%
Since their Zoo trip have considered how their actions affect the environment	35%	30%
Remembered Quest message	79%	n/a
Talked about Quest message	76%	n/a

Other effective tools focus on methods of presenting the information. If your audience is full of people that don't particularly care about the environment, frame your information to appeal to their interests, like money (Cross, 2015). Telling them about the number of trees that will be saved will not have much effect, but telling them about how much money they would save might get through to them.

This is because values do not predict behavior, rather, behavior is a predictor of values (Cross, 2015). A group of people trying to enact positive environmental change would likely report that they care about the environment, but a survey of random people and even if someone says that they care about the environment, that doesn't mean that they act on that feeling. So first, get people to do something about it, and then, they will either have already cared, or they will likely start to care. Or, as the psychologist Edward Deci put it, "Instead of asking 'How can I motivate people?' we should be asking 'How can I create the conditions within which people will motivate themselves?'" (Deci, 1975)

Many people consider themselves "hands-on" learners, even though most learning environments aim more toward passive learning. But, as Sharon T Steinemann, Elisa D Mekler, and Klaus Opwis found in their research, interactivity has a greater effect on the participant. They were testing the effectiveness of a genre of video games called "games for change", and examining the role that interactivity and presentation mode play in the results. Games for change take an issue, such as environmental, social, political, or humanitarian issues, and present them to the player in a different way, through playing a fun video game. In their study, they had 234 participants either play, watch, or read through one of six variations of the game *Darfur is Dying*. This game confronts players with the fear and constant lack of security facing Darfurian

refugees, by forcing the players to attempt to bring water back to their camp. Following that, they asked them to choose the percentage of an unexpected bonus to donate to a charity. The donation percentages can be found in Table 2.5. On average, donations increased among the interactive participants by 12%. Presentation mode, however, had no effect on the donation percentages. (Steinneman, et al., 2015) A summary of their results can be found below.

Table 2.5 – Donation Percentage Results

	Non-interactive			Interactive		
	Text	Text w/ Pictures	Recorded Gameplay	Text	Text w/ Pictures	Gameplay
Percentage of Unexpected Bonus Donated	49.42%	52.56%	50.75%	65.12%	55.16%	66.55%

We can see that in all three presentation modes, the addition of interactivity has a positive impact on percentage donated, but that isn't the only category that was measured. Role-taking, enjoyment, appreciation, willingness to help, empathic concern, and humanitarian involvement also saw in increase when interactivity was involved. This finding reinforces what has been found in other research, such as in the article by James Paul Gee. In his article, *Deep learning properties of good digital games: How far can they go,* Gee states, "...the deepest and most important properties of entertainment digital games that allow them to achieve power learning effects, in the sense of both learning to play the game...and of creating commitment and attachment to play and learning in the game." He then lists some of those properties, and property six is especially important in explaining how interactivity has the effect we see above. "Property 6: Games as player-enacted stories or trajectories." When interactivity is a factor in a game, when the player has the ability to affect the direction the story develops or the way it

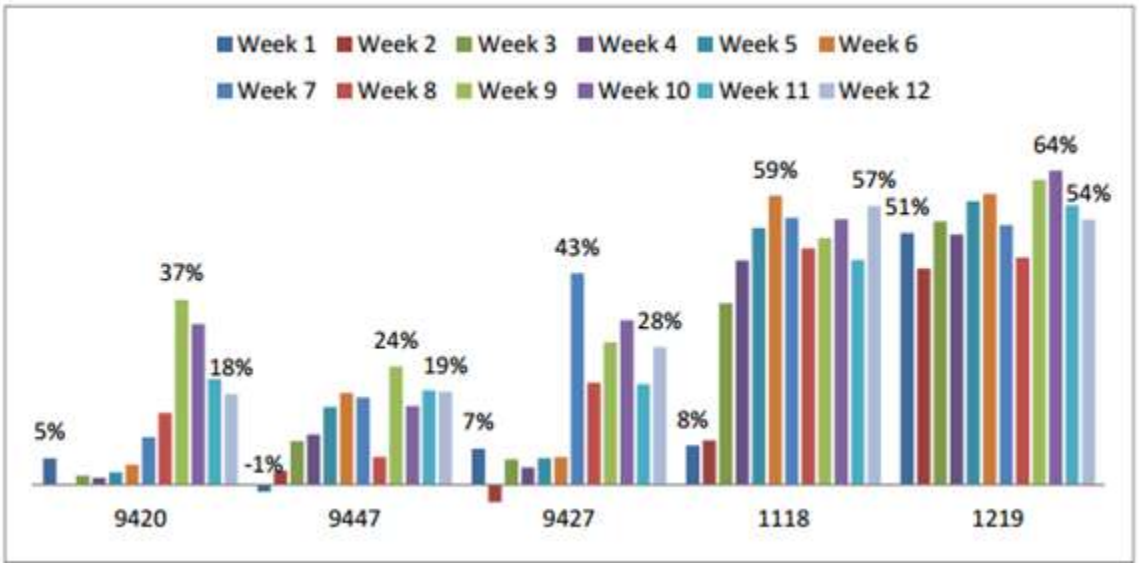
unfolds, it becomes personal. The avatar or character is no longer the character designed by the creator, it has melded with the player to become unique through the player's interaction. This makes the story and events of that world special to the player, as they brought it to what it is. Most players even find it very easy to go from saying, "the character beat the final boss", to saying, "I beat the final boss." Even this nuance shows how personal the world, events, and character are to the player. This same effect is not realized when interactivity isn't a factor. No one reads Harry Potter and says, "I defeated Voldemort."

Effective Strategies for Interactive Design Installations

Jeni Cross is a sociologist who has dedicated much research to decision making, particularly with regards to energy conservation, land conservation, and sustainability. In a talk she gave in Fort Collins, she discussed myths about behavior change. She mentions that just presenting the information to the audience isn't effective and that social interaction is important for your information to really hit home with them. Most of the rest of her talk is about changing people's behavior, but some of those strategies can still be helpful in interactive learning. "Set behavioral expectations." To elaborate, don't tell someone they should be more environmentally friendly, to conserve energy, or cut utility costs because these things are too broad. Be specific and tell them, "shut the light off when you leave the room" or in the office, "turn off your computer when you leave work." These things are specific behaviors you would like them to do in order to achieve some greater goal. While she is framing this toward behavior change, the principles behind it can still be useful. If we're seeking to create a learning environment, we should avoid broad statements and information, and keep it simple. Avoid using large, sweeping statistics and focus on small problems and the behaviors that can cause that problem.

Kathleen Judd, Thomas Sanquist, Mary Zalesny, and Nicholas Fernandez showed in their experiment with the staff at Fort Carson in Colorado Springs that setting behavioral expectations works. They set two behavioral expectations: shut your computer down at night and turn back the thermostat on your workspace heating/cooling unit each night. Table 2.6 below shows the results over 12 weeks for five buildings throughout Fort Carson. In building number 1118, they only had 8% of their computers shutdown during the first week, as opposed to 59% during week 6. Interestingly, building number 1219 started with 51% and fluctuated but by week 12 they did not see much difference. Overall, however, most of the buildings saw at least a 300% increase.

Table 2.6 - Initial Survey Breakdown



Data on the thermostat intervention was done on a self-report basis and the results indicated that between 23% and 32% more occupants turned back temperature settings on their workspace heating units each night. Encouraging results for a three month intervention period. They also did a survey on the attitudes of participants. In the initial survey 76% of the participants stated that they believed reducing energy use in their building was important. This number increased to 92% after the three month intervention experiment.

Once the current reinforcement of that behavior is gone, how do we ensure that the behavior change lasts, how do we ensure that they don't simply go back to how things were before? As we saw with the Bog of Habits exhibit at the Brookfield Zoo in Illinois, the behavior change doesn't last without some sort of reinforcement. So, some other element is needed. That is where The Social Stairs comes in.

Michel Peeters, Carl Megens, Elise van den Hoven, Caroline Hummels, and Aarnout Brombacher did a study to expand on the success of The Fun Theory's Piano Stairs. In an attempt to take the Piano Stairs to long term behavior change, they referred to BJ Fogg's behavior Model, which "...describes three elements that must converge at the same moment for a behavior to occur: Motivation, Ability, and Trigger. When behavior change does not occur, at least one of those three elements is missing" (Fogg, 2009). Using "IJsselsteijn et al. (2006) as a point of reference, they note that changing human behavior typically takes a long time. To their knowledge, there are 'hardly any user studies available that have looked at the long-term effectiveness of persuasive technology.'" With this information, they developed and implemented The Social Stairs to see if design could …"evoke emerging or changing behavior that will lead to people's intrinsic motivation in the long term to take the stairs in favor of the elevator" (Peeters, et al., 2013).

The Social Stairs were similar to the Piano Stairs, but with some differences. The steps weren't mapped to create sounds similar to a piano, they made different sounds as they created different iterations. Another key difference was that the sounds changed depending on the number of people using the stairs, creating a social aspect that got people to get other people to

take the stairs. This social aspect is important, as that is one of the key factors that made this work, and could be very useful when designing interactive learning environment.

BJ Fogg (2009) identified three things as being necessary for behavior change to occur; motivation, ability, and trigger. It is clear that nothing changed in regards to ability, but trigger and motivation did change. Peeters states that the triggers were "...'open scripts' which would evolve over time…With the Social Stairs we wanted to design and probe towards triggering people's intrinsic motivation to take the stairs" (Peeters, et al., 2013).

In order to move toward long term behavior change, they turned to the work of White (1959) and Deci (1975) "…where intrinsic motivation refers to motivation to enact a behavior for its inherent satisfaction, in alignment with one's personal values or attitudes, and not for a separable external consequence. Moreover, intrinsic motivation seems to increase the likelihood of the behavior being performed (Deci, 1975) and seems to lead to sustained behavior (Deci, 1975)."

What they're deducing based on this information and their experiment with the Social Stairs is that for behavior change to be long term, it needs to come from within, not triggered by extrinsic persuasion. But, they also state that it is difficult to predict which trigger will lead to intrinsic motivation in the long term.

These strategies for changing behavior can also be applied to interactive learning environments. On some level, changing a behavior involves accepting new information, exactly what information is being accepted isn't easy to control. They may simply accept the new behavior as something they have to do, that they aren't given a choice in the matter, as in the case of Fort Carson where they weren't doing so because they wanted to. But what we're hoping

to do is to teach them new information through an interactive exhibit, and have them accept this new information as something that is important, and hopefully that they will someday act on that information.

How Interactivity Makes for Effective Learning

When it comes to interactive learning, many people seem to think that it is for children. This can be seen through the use of children's games that teach typing and math through fun, interactive games while few things like that are geared toward adults. In museums as well, when they have interactive exhibits which are intended to inform, many visitors are of the opinion that they are geared toward children. Referring to an article by Andrew Pekarik et al. "Although both children and adults are drawn to these interactives and make use of them, they tend to be thought of as child-oriented…" (Pekarik, et al., 2002). This thought of interactive things as being intended for or only useful to children is a potential barrier, if your intended audience includes adults, but one could also say that having an influence on children is more important as they are the future. Either way, interactive learning through exhibits, games, or environments enhances the learning experience for people of all ages.

People learn better when there is a connection to the material, or when they are interested. As Annie Paul said, "Interest is at once a cognitive state and an affective state, what Silvia calls a 'knowledge emotion.' The feelings that characterize interest are overwhelmingly positive: a sense of being energized and invigorated, captivated and enthralled. As for its effects on cognition: interest effectively turbocharges our thinking" (Paul, 2013). That is definitely a state we want people to be in while we are trying to teach them about something.

But how can interactivity be used to create this interest? Well, Annie Paul quotes educator John Dewey as stating that "…interest operates by a process of 'catch' and 'hold' – first the individual's interest must be captured, and then it must be maintained" (Paul, 2013). Essentially, this means that there are two types of interest, or as Renninger describes it in her book, *The Role of Interest in Learning and Development*, there is situational interest and individual interest. In our comparison, situational interest would be the "catch" because it "…can only result from an interaction between the person and the environment…" but may "…contribute to the development of a long-lasting individual interest" (Renninger, 1992). Individual interest being our "hold" and a long term interest that contributes to enhanced learning. What all of this means for interactivity is that, if the exhibit is structured in such a way as to catch the audiences' attention, which exhibits often do, the interactivity can bring about the transition from "catch" to "hold" in part because of how it internalizes the subject matter (Gee, 2009).

CHAPTER 3

CREATIVE WORKS

Soil Erosion

Introduction

One of the main issues I wanted to take on in these prototypes was the issue of soil erosion, and the impact it has on water. Soil erosion reduces cropland productivity and contributes to the pollution of adjacent watercourses, wetlands and lakes. When soil is carried away and down waterways it can fill in drainage channels. One of the best ways to impact this issue is through the installation of prairie strips in farms. Prairie strips are small strips of prairie plants, which are installed parallel to the land contour, such that water will have to run through the prairie strips before exiting the farm and entering the waterways. Prairie plants have the deepest roots and absorb more water than any plants, so they would hold the soil in place.

This prototype involved creating 3 troughs to hold the soil and 3 receiving tubes to catch the runoff, all made out of Plexiglas. The troughs are just slightly tilted so that the water will drain toward one end. Each of the troughs is filled with the same soil, one trough has two strips of wheatgrass to represent prairie, one has one strip, and one has only the soil. This can be seen in the upper left image of Figure 3.1. Water is then slowly poured in on the high end, the water runs through the soil and slowly pours out the low end into the receiving tubes. By the end of the day, the three tubes had very different water compositions, illustrating how much soil was held in place by the roots.

Figure 3.1 – Displaying Soil Erosion project.

Demonstrations

Participants would be handed a cup of water and would be told to pour water into the troughs, and then observe as it moved through the trough. They could then watch as the water exited the trough and see the difference in water quality as it is building up in the receiving tubes. I would set it up in multiple public places in a few different towns and recruit people as they pass by. If an agricultural convention or some other kind of gathering of people in the agriculture industry was available, that would be a more ideal place to exhibit this prototype.

Conclusions

The goal with this installation is to show people the difference that prairie strips can make in the runoff problem. This would obviously have the most impact with those in the agricultural industry. That doesn't just mean farmers either, policy makers are also in the target audience, because they have a great deal of impact on the farming community.

The thought here is that there are a few barriers preventing the adoption of progressive farming practices, such as financial concerns, lack of knowledge regarding the importance of progressive farming practices, or a lack of awareness of the alternative practices in general. The hope then, is that this installation will show them the importance of progressive practices, and the importance of prairie strips specifically, but also just simply informing them that such a thing is an option. Referring back to James Paul Gee (2009), who said that the interactive nature of games makes it more personal, well this installation being interactive makes it so that the people pouring the water, are connecting with the installation. When doing this, it will make them want to know more, this is because of the interest that is built from the interactivity, as Annie Paul (2013) said, it turbocharges thinking, they brain is alight with thoughts and they want to know more about the installation. If they were allowed to observe passively, there would be little interest, nothing connecting them to the installation, and they would gain little.

Map of Iowa Board Game

Introduction

The first prototype focused on one specific issue, this prototype focused on environmental behavior in general. This prototype is a board game that presents environmental issues as obstacles to be overcome with all the players working together to build a better world. The map is different every time the game is played, with the tiles being randomly laid out in a shape of the players' choosing. Initially each tile is flipped to the "bad" side and through gameplay the tiles get flipped to the "good" side, indicated by the "bad" side having a clearly visible red tint. The game is won when every tile gets flipped to the good side. At the beginning of a player's turn, they roll a die to determine the number of "Action Points (AP)" they have this turn. One AP is used for each action, so moving one space uses one AP and flipping a tile uses one AP. But, there is a non-player force working against them. At the end of each round the "Corporate Boss" takes a turn and moves about the board, afterward an "Uh-Oh" card is pulled and disaster markers are placed around the board based on the movement of the "Corporate Boss". A tile cannot be flipped to the "good" side while a disaster marker is on it, and a player will have to use an AP to clear the disaster marker from the tile.

Environmental issues are presented to the players through the images on the game board tiles and through the Uh-Oh cards. Each Uh-Oh card details an environmental problem and a consequence of that problem. The effect they have on the board is to make it more difficult to flip tiles to the good side, but their real purpose is to present these issues to the players in a different manner than is typically tried. During play, they are taking on the role of someone

combatting environmental problems, and when an environmental problem is presented to them as an obstacle that they must overcome, it takes on a different schema in their mind.

Since saving the planet in the real world is a time sensitive task, the game is lost when the board isn't flipped within a predetermined number of turns or if each tile gets covered with a disaster marker. Players therefore have to fix the world within a certain number of turns while mitigating the disasters that are continually being created. Figure 3.2 through 3.15 detail an instructional booklet that was made for the game, then Figures 3.16 through 3.19 illustrate the board game tiles and cards .

Figure 3.2 – Instructional booklet for Map of Iowa

Figure 3.3 – Overview page to give context to the players.

Figure 3.4 – Contents page. Lists the contents that should be found within the box.

Figure 3.5 – Set Up page. Gives details on how to lay the board out.

Figure 3.6 – Assigning Jobs page. Explains how to distribute jobs between players.

Figure 3.7 – Assigning Jobs page continued. Gives more details on jobs.

Figure 3.8 – Assigning Jobs page continued. Gives more details on jobs.

Figure 3.9 – Playing the Game page. Explains how a round is played.

Figure 3.10 – Player Turn page. Explains how each turn is played out.

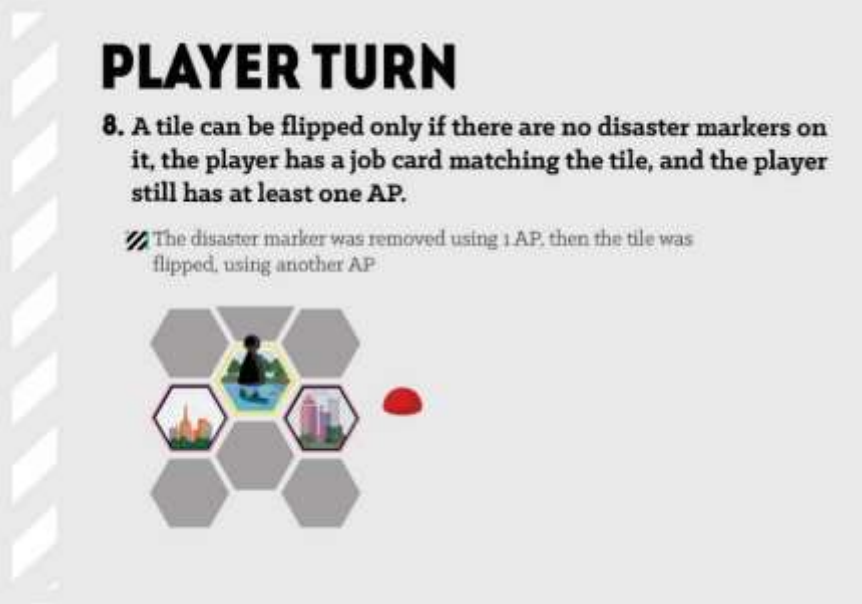


Figure 3.11 – Player Turn continued. More details on turns.

Figure 3.12 – Player Turn continued. More details on turns.

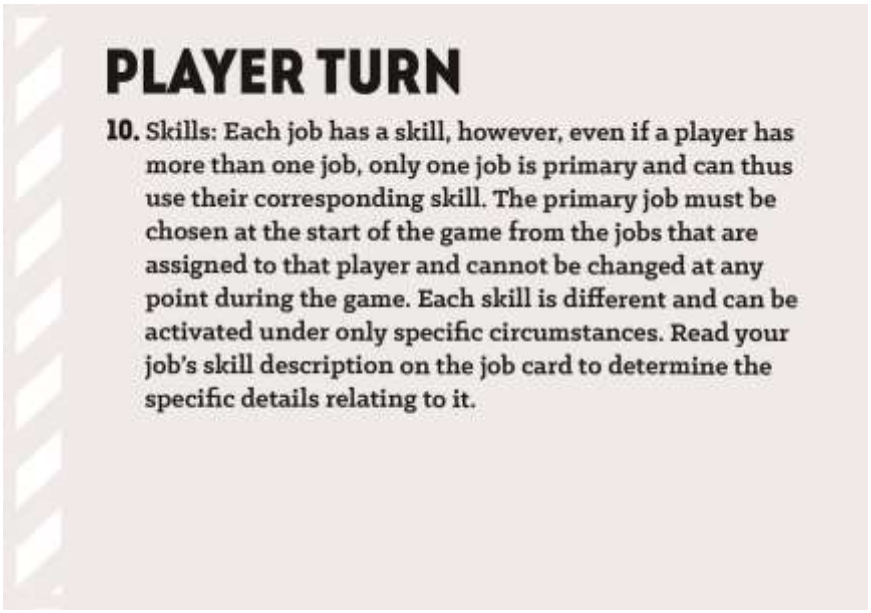


Figure 3.13 – Player Turn continued. More details on turns.

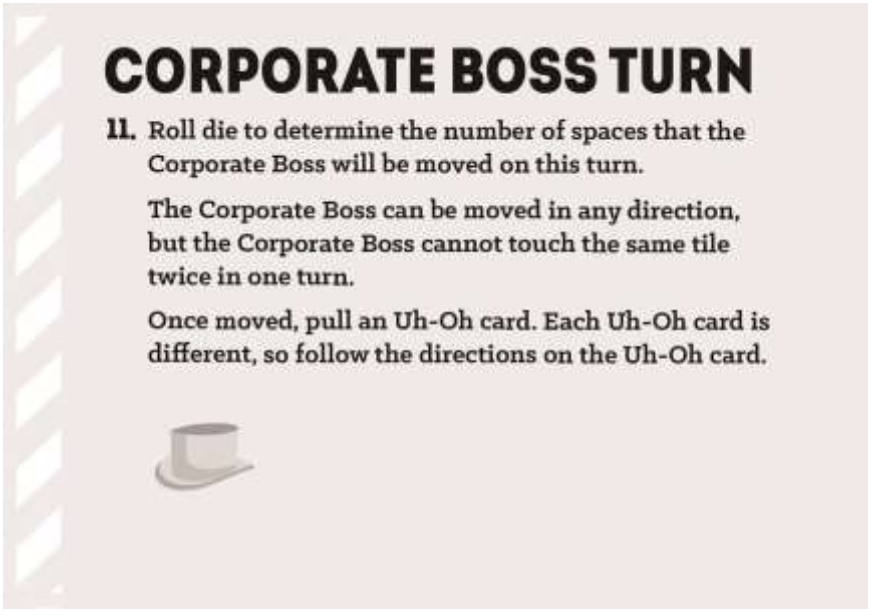


Figure 3.14 – Corporate Boss Turn. Explains how the Corporate Boss' turn is done.

Figure 3.15 – Beating the Game. Explains how the game is won or lost.

Figure 3.16 – Photos of Map of Iowa laid out on a table.

Figure 3.17 – Illustrations I made for the Map of Iowa board game.

Figure 3.18 – Map of Iowa job cards, front and back.

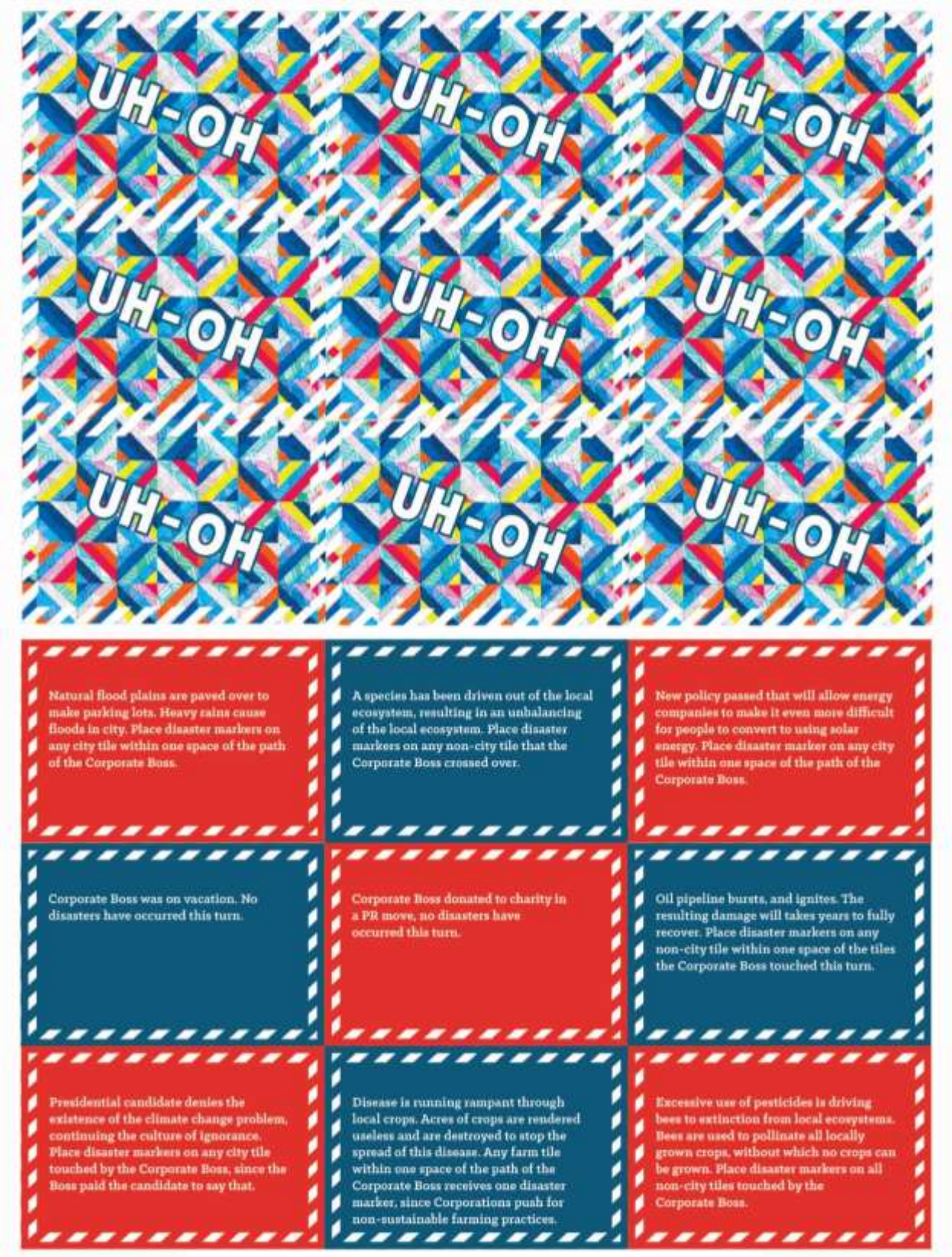


Figure 3.19 – Examples of Map of Iowa Uh-Oh cards.

Demonstration

Obviously this game would have the greatest impact if it became popular and ended up on store shelves and was as widespread as Monopoly. But, for now, I would take it to public places where people were already intending to spend an extended amount of time. Like diners, coffee shops, and cafes. I would set it out on a table and ask people if they would like to play a game. I'd give a brief run-through of gameplay and the amount of time they should expect it to take. Instructions would be laid out with the game for them to reference. I would then observe their reactions to the theme and note the tone and topic of their conversations. A game like this, with a fairly obvious theme and goal, could very easily meet some hostility with unsuspecting players. Some people get defensive or even hostile when presented with environmental issues. With that in mind, it would probably have a more positive and lasting effect if presented to children before they've had the chance to form such biases.

Conclusions

The audience here differs from the first prototype, because it is directed at anyone willing to play a board game. What we are out to change with this board game is their understanding of the problem, while subconsciously changing the way they think about the problem. To elaborate, they take part in the fixing of the environmental problems, this will hopefully get them thinking that they can be part of the solution, especially if they play the game at a young age. Taking the social stairs into account (Peeters, 2013), I wanted this project to have that social element in the hopes that it would help it to appeal to intrinsic motivation. That, as Edward Deci said (1975), would mean that the motivation was coming from within. If we were able to internalize the topics presented in this game, through interactivity and the social aspect working together, we

might get the topics to be burrowed into their mind, taken with them wherever they go. That and the fun of playing a game which, as The Fun Theory has shown, can really change the playing field.

Interactive Prairie Animation

Introduction

The third prototype takes a more technological approach by making an interactive animation. Utilizing a computer, a projector, and a Microsoft Kinect Sensor, we can make an animation display on a wall or projector screen that a viewer can interact with. The Kinect Sensor can pick up hand and arm movements and even specific hand gestures, so the interaction is mostly natural. The animation itself consists of a farm on a sloped terrain with a river at the base and a rain cloud in the sky above the highest part of the hill.

When the viewer moves their hand over the cloud and pokes or squeezes, it will start to rain for a period. Continued interaction with the cloud increases the severity of the rain. When the water from the cloud reaches the farm, it begins to move toward the river, carrying the nutrients from the fertilizer with it. This is meant to illustrate fertilizer runoff and when the water runs through the farm, the viewer will be able to see the fertilizer entering the waterways.

The viewer can do something about the runoff however, by planting one or more strips of prairie plants along the farm. When the prairie strips are planted, the viewer witnesses the depth at which the roots expand and can see how they stop the water. Figures 3.20 through 3.24 below show the interactive animation in action.

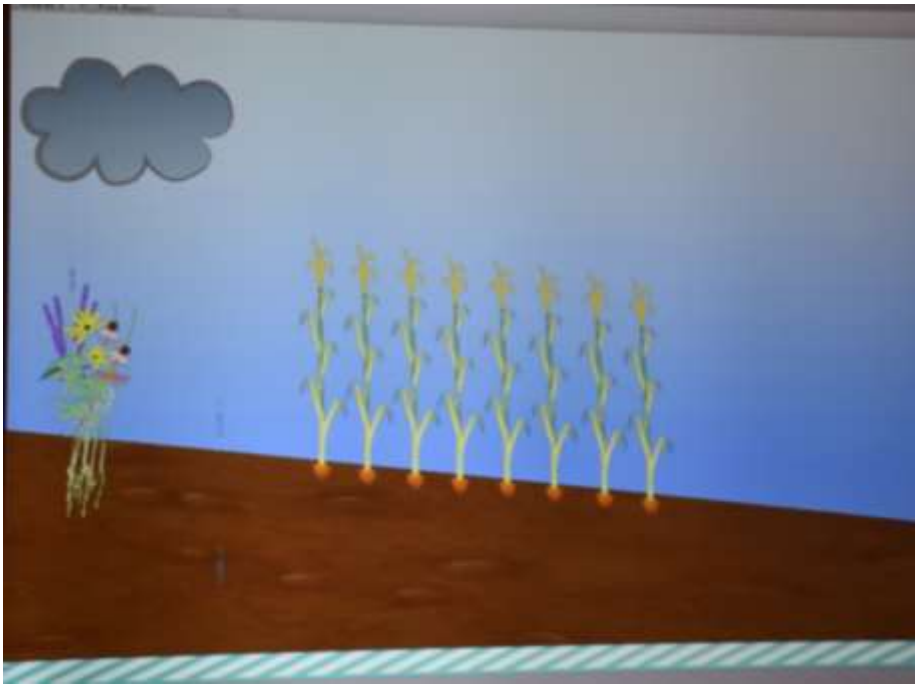


Figure 3.20 – Demonstrating the interactive animation.

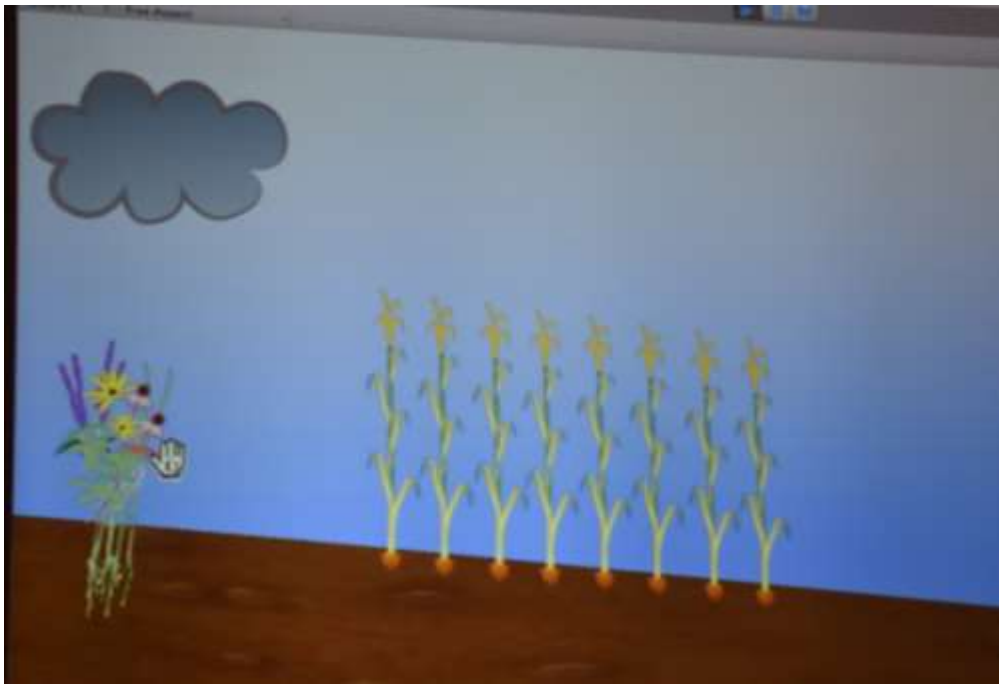


Figure 3.21 – Moving the cursor over of the prairie.

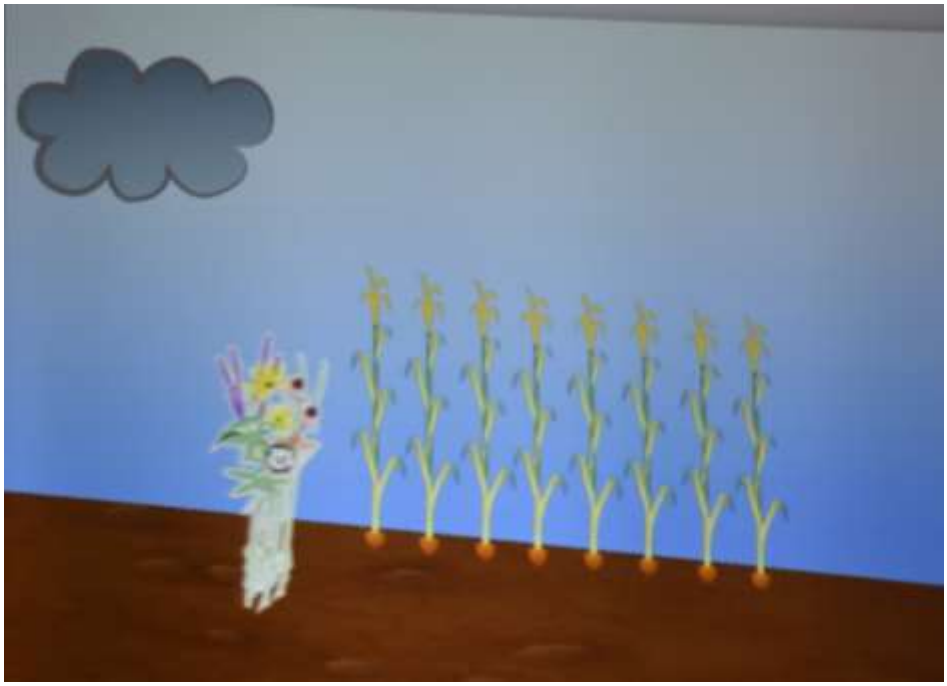


Figure 3.22 – Grabbing and moving the prairie

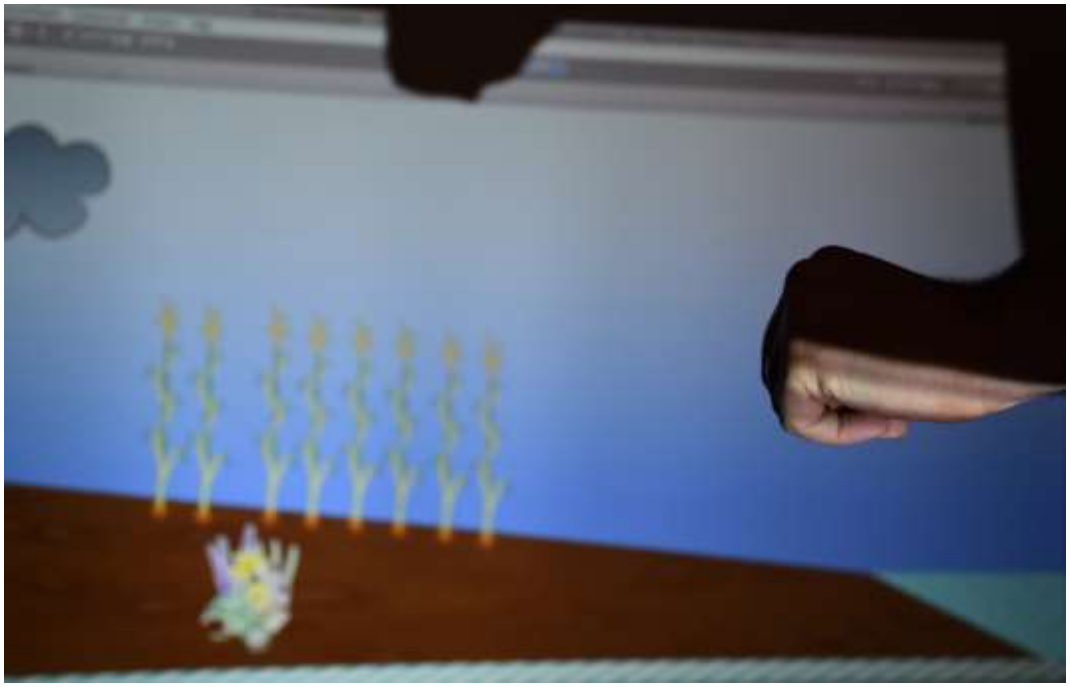


Figure 3.23 – The prairie is being moved with natural movements.

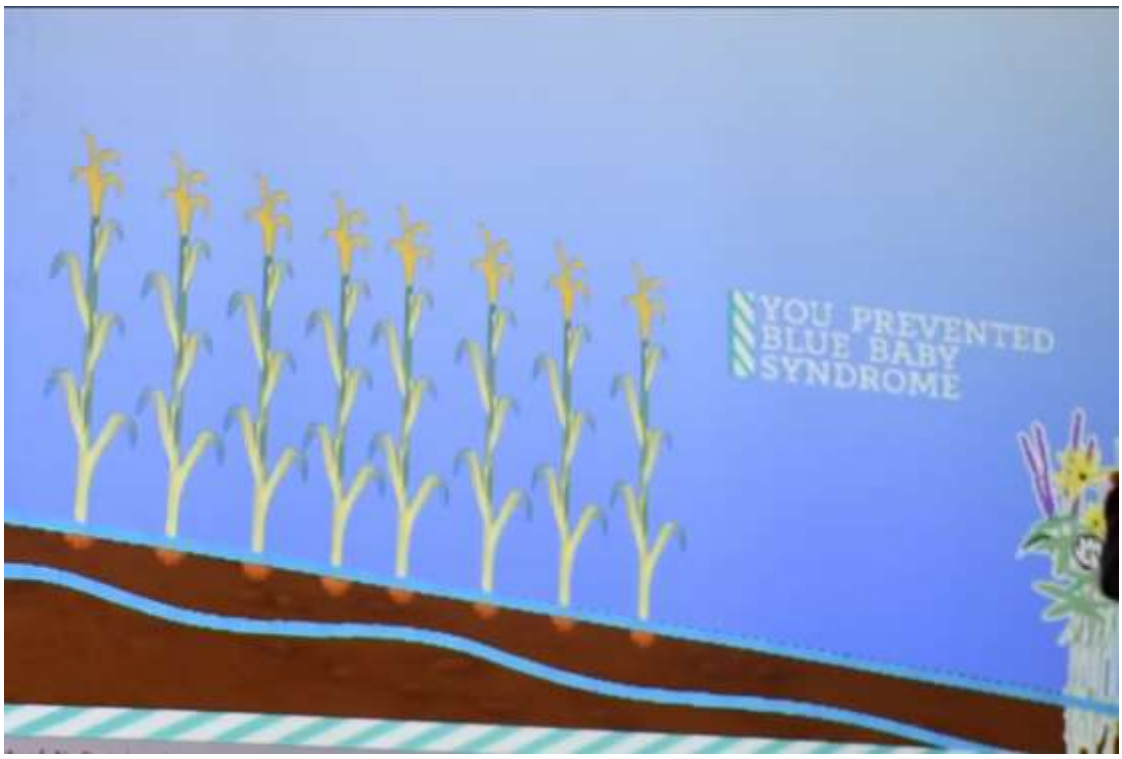


Figure 3.24 – Screen when the prairie is successfully installed.

Demonstration

One of the reasons for using touch or gesture based interactive demonstrations like this is that very little instruction is needed, because it can have a very organic control scheme. Stand in front of it, then reach out and touch the cloud to make it rain. The only instructions that need to be given to the participants is delivered on screen. If the animation sits for long enough, words will be displayed that say to touch the cloud. After touching the cloud and letting the rain fall, it will say to pick up the prairie and place it between the corn and the river. If that action is not performed and it sits still long enough, it will reset to the original set of instructions.

If after interacting with the animation, the participants have questions, like “What is it about?” I would be standing nearby to answer those questions. They would likely have gleaned some basic understanding from the animation, but it doesn’t provide them the words necessary to

understand it completely. With a slight explanation to fill in the blanks, they would have a clearer understanding, and many people would continue to pursue information, asking a follow up question like, “What type of plants were those that stopped the water?” I would then answer that question and any other questions they might have and hand them a flyer, pamphlet, or brochure with more information and the web address of the ISU STRIPS Project website.

Conclusions

The ideal audience for such an interactive exhibit would be for those who could make a difference to experience the interaction. This would be lawmakers and farmers. Such an audience would most easily be reached at agricultural conventions and the hope would be that the interaction gets through to them in ways that an infographic, commercial, or other methods don’t. The interactive nature of the installation will resonate with the viewer/user more than passive installations because they themselves plant the prairie, bring the rain, and wash the fertilizer away. They becomes part of the story, and so identify with it differently. After playing with the animation, they can say, “I planted prairie in that farm and stopped the fertilizer from washing away.” This is important because of James Paul Gee’s (Gee, 2009) sixth property of games as tools for learning, “Games as player-enacted stories or trajectories” When interactivity is a factor in a game, when the player has the ability to affect the direction the story develops or the way it unfolds, it becomes personal. And that personal level of involvement in the material gives it more meaning.

Augmented Reality STRIPS Project

Introduction

One of the first prototypes I worked on, which will certainly be fully completed and implemented at a later date, is the Augmented Reality Sandbox (AR Sandbox). The base program and functionality was completed, but many of the additions that I wanted to add have been delayed.

The AR Sandbox, at its basic level, has been done before and videos have circulated the internet and social media sites. It is a sandbox that has a topographical map projected on top of it, and as the sand is moved, a Microsoft Kinect Sensor measures the distance to the sand and updates the map according to the new elevations. I made one that holds 150 pounds of sand and was able to digitally simulate water moving from higher elevations to lower elevations. The water was added to the simulation by having it rain down on any area that had an object above a certain elevation. It was originally put together without a larger plan for how it would be used, mostly out of curiosity at what it could do. While the AR Sandbox was on display at an open design studio event, I was approached by Matthew O'Neal, Associate Professor of Entomology at Iowa State University and ISU STRIPS Project investigator.

After talking with O'Neal, it was decided that the AR Sandbox project would be used to make an interactive demonstration on how Prairie Strips help to keep runoff under control. We would do so by changing the software to have it render farmland anywhere with a certain amount of space between a certain elevation. Then when water runs over it, the water would change color, indicating that it had picked up fertilizer and that would then spread to lower elevations and bodies of water, illustrating how runoff can migrate far from the source and pollute rivers,

lakes, and oceans. Then, through an as of yet undetermined procedure, prairie strips could be added to the farmland to prevent the runoff. And the “board” could be cleared through a keystroke on the laptop running the simulation.

Problems were encountered due to limitations and difficulties with dependencies required by the base software package. As such, it was decided that it would be remade from scratch using the Unity 3D software development platform as that would allow us to make it more user friendly and it would function on more platforms with easy portability. This proved to still be a very long process and so was put on hold. Figure 3.25 and 3.26 show the Augmented Reality Sandbox without the additional features. Figures 3.27 through 3.29 show the additional features of drawing in squares that are then rendered as farmland and drawing in the prairie strips.

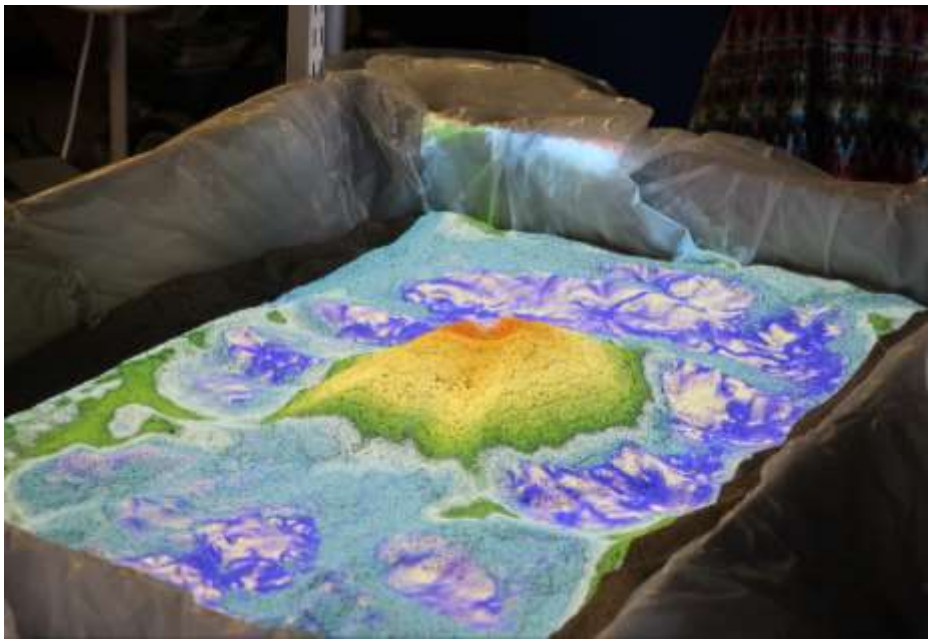


Figure 3.25 – The first version of the Sandbox.

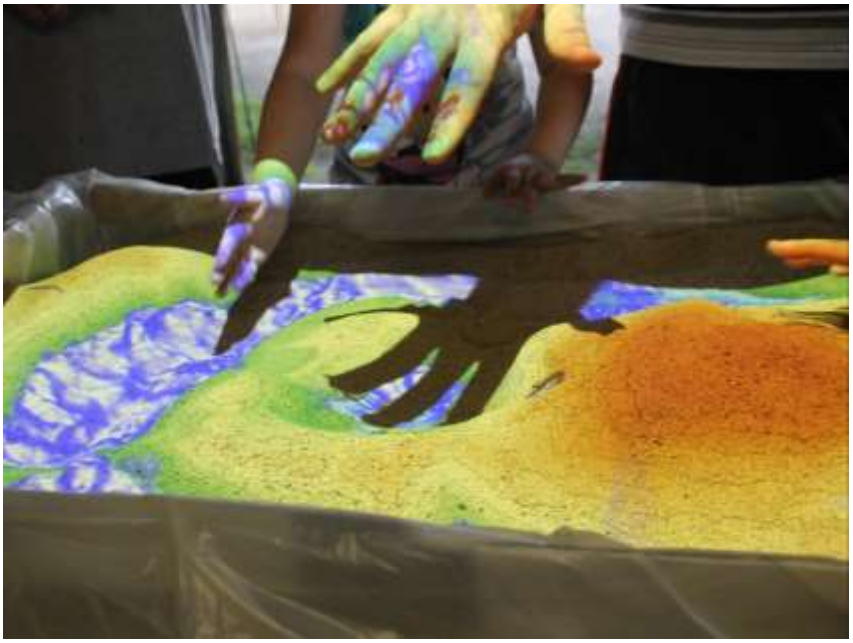


Figure 3.26 – Demonstration of making it rain by holding hand at upper elevation.

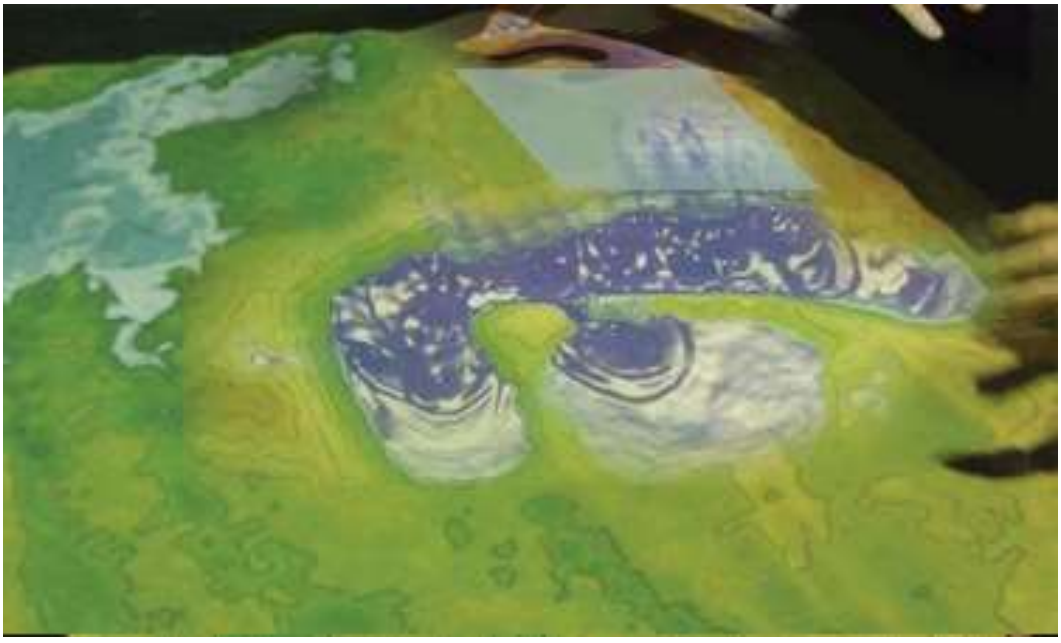


Figure 3.27 – Drawing a region to be designated as farmland.

Figure 3.28 – Another example of creating farmland.

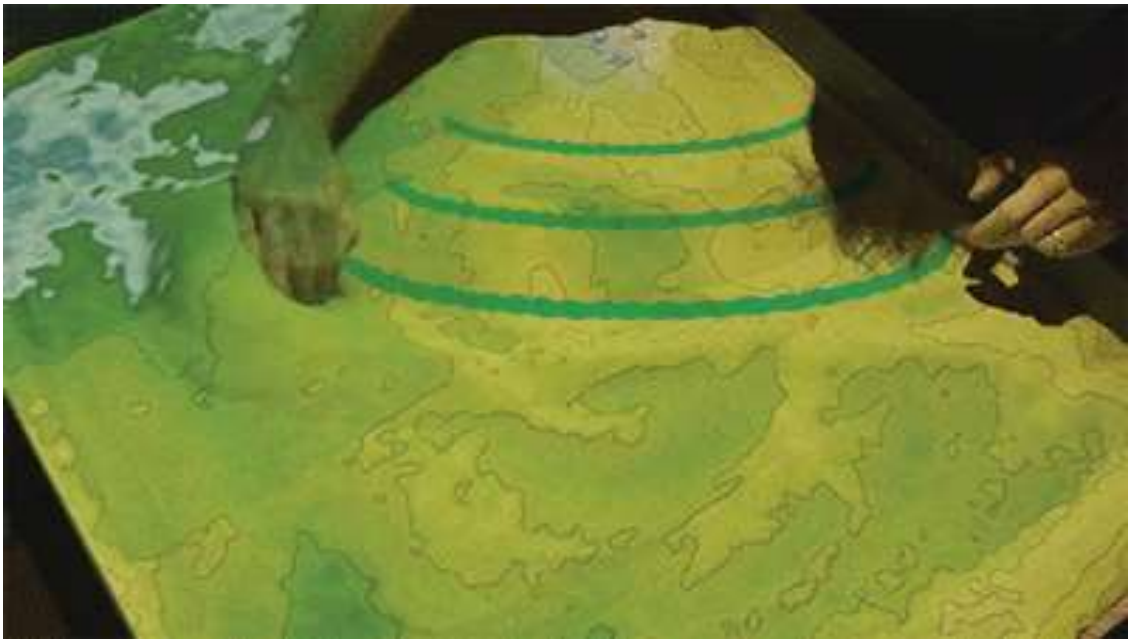


Figure 3.29 – Drawing in prairie strips.

Demonstration

Once complete, the plan is to exhibit the project at an annual convention help in February with Professor O'Neal there to talk with visitors about the STRIPS project. The idea is that the AR Sandbox provides an opportunity to grab and hold peoples' attention and then further provides a visual demonstration of the STRIPS project, which is a bit difficult to describe properly in words alone. But as we've noted previously, interactivity is also a great medium for changing behavior. More than just a visual demonstration, it allows them to become part of the narration, and combined with O'Neal's explanations and knowledge, we have a very persuasive tool in a location where it is very relevant.

Conclusions

Once finished it should be a very powerful tool for teaching people, and not just about prairie strips, but about many different things within landscape, geology, and agriculture. The hope is that it could even become a permanent fixture somewhere, like an agricultural museum or convention center. I hope to package the software with instructions for building a similar structure and distribute it to others who want to build one, in the hopes that it can be used to educate future generations on the importance of progressive agricultural practices.

This augmented reality sandbox is a lot of fun (The Fun Theory, 2014); without even understanding it's intended purpose, a person could play with it for an hour without even discovering the additional features such as making water rain down. It certainly generates interest (Paul, 2013), merely upon seeing the initial version of the sandbox, people were entranced by it. It brings people in closer, they want to know more about how it works, and before I even thought about using it to teach people about environmental issues or prairie strips,

people were considering how it could be used to such ends. There is also a social aspect to it too, people would often work together to change the landscape, working from both sides to make a giant mountain in the middle of the sandbox which often led to discussion, and when one person starts to bounce ideas off of another person, great things can happen.

Summary

Table 3.1 – Summary of Creative Works

Project	Intended actions	Learning	Interactivity
Soil Erosion	Pour water into one of three soil filled troughs, then observe as the water moves through the soil and pours out the other end.	Participants learn about soil erosion, its causes, its results, and how prairie strips can help alleviate the problem.	The act of pouring the water changes the interaction and causes a different reaction from the participants. This leads to participants wanting to know more about what they're doing.
Map of Iowa	Play a board game and work with the other players to save the environment.	The board game contains a lot of elements about environmental issues threatening the state of Iowa.	Playing a board game is fun, so sets the players in a positive state of mind. They are working together to win against the environmental problems, rather than each other. It also shows that environmental problems are an issue they can and should do something about, rather than relying on the government or other organizations.
Interactive Prairie STRIPS Animation	Use hand gestures to move prairie plants in the path of water running off a farm.	A visual demonstration of how prairie can help to prevent soil erosion. Also provides information on some of the problems caused by soil erosion.	It requires very little instruction, but a fair amount of interaction. Upon first interaction, the participant will likely fail to stop the water, resulting in seeing the result. On the next attempt, they should succeed and will be rewarded by the interactive animation telling them they did something or saved the day. Providing them with only some of the information, and using interactivity to make it more personal, they will seek more information.

Table 3.1 – Summary of Creative Works continued

Project	Intended Actions	Learning	Interactivity
Augmented Reality STRIPS Project	Play with the sand and topographical map. Then discover its other functionality. Draw farm, make it rain, see results. Install prairie strips. See the new results.	Participants learn about soil erosion from a new angle, a bird's-eye view. The Augmented Reality STRIPS Project allows them to see the whole picture. To watch as the water moves across a large distance. And then they see the difference that the prairie strips make.	The Augmented Reality (AR) Sandbox is very fun and it generates a lot of interest through that fun and through the interaction. This leads to a lot of questions, about the technology and the purpose. The result is a person interested about the topic you are presenting, and it usually leads to discussion between participants as well.

CHAPTER IV

CONCLUSION

At the heart of the environmental issues of today there is a lot of bad information. This is further fueled by myriad negative influences from media and advertising. Many people are at some level aware that they shouldn't be wasteful, shouldn't litter, and should recycle, but that isn't enough. This is why putting together exhibits that inform and create interest either consciously or subconsciously is so important.

Examining other interactive exhibits and existing research into the psychology of interactivity and learning provides useful insight into interactive learning. Existing research on interactive design being used for learning was limited, but research on behavior change, interactivity, learning and even interactive learning in general was plentiful and combined painted a useful picture.

Research by Steinneman et al., for example, showed that subjects that played the interactive version of the game contributed more. James Paul Gee (2009) tells us that interactivity makes the topic more personal, and Annie Paul (2013) says that interest supercharges learning. Thus, it stands to reason that since topics that are more personal, generally sustain greater interest (Renninger, 1992), and since interest drives learning (Paul, 2013), and interactivity can make topics more personal (Gee, 2009), interactivity can lead to better learning. There is more to this equation however, as the interactivity has to do its job well for this equation to flow properly. Fun stands to be an excellent catalyst toward that, however,

for two reasons. As Ann Renninger stated, situational interest can lead to individual interest (Renninger, 1992) and situational interest is just like the “catch” that Annie Paul quotes John Dewey as stating as a necessary component of interest (Paul, 2013). Since fun is generally something that most of us find interesting, fun is the catch and interactivity is the hold, and the information delivered through the interactive exhibit is what they’ll learn.

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